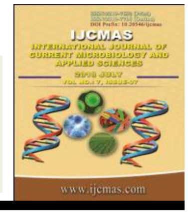
Int.J.Curr.Microbiol.App.Sci (2018) *7*(7): 1820-1826

EXCELLENT PUBLISHERS

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 7 Number 07 (2018)**
Journal homepage: http://www.ijcmas.com



Original Research Article

https://doi.org/10.20546/ijcmas.2018.707.215

Evaluation of Insecticide Mixtures against Larval Population of Spotted Pod Borer, *Maruca vitrata* in Cowpea

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A B S T R A C T

Keywords

Efficacy, Insecticide mixtures, Pod borer.

Article Info

Accepted:
15 June 2018
Available Online:
10 July 2018

Evaluation of efficacy of insecticide mixtures against the spottedpod borer, *Maruca vitrata* was conducted at College of Agriculture, Vellayani, Thiruvananthapuram during 2017. The result revealed that no larva was found in the treatment lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC @ 0.50 mL L^{-1} and chlorantraniliprole 8.8 % + thiamethoxam 17.5 % SC @ 0.30 mL L^{-1} treated plants after 5 days of spraying. Then from 7 seven days after spraying no larvae was recorded in the treatment lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC @ 0.50 mL L^{-1} only and less number of larvae was recorded in chlorantraniliprole 8.8 % + thiamethoxam 17.5 % SC @ 0.30 mL L^{-1} followed by beta cyfluthrin 8.91% + imidacloprid 19.81 % SC @ 0.40 mL L^{-1}. The existing management practices with single insecticides are meagre to meet the demand. Hence the present findings of the experiment concluded that the use of ready-mix formulation lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC @ 0.50 mL L^{-1} is found to be superior to control larval population in cowpea.

Introduction

Cowpea (*Vigna unguiculata* subsp. Sequipedalis (L.) Verdc.) generally termed as yard long bean is the most widely adapted, versatile and nutritious grain legume crop in tropical and sub- tropical countries. As many as 21 insect pests of different groups are recorded damaging the cowpea crop from germination to maturity (Sardhana and Verma, 1986). Spotted pod borer is the most dangerous and potential pest creating considerable damage to the crops by infesting flowers and pods.

Webbing of leaves and scrapping followed by feeding on developing seeds inside the pods results in higher yield loss up to 60 per cent in cowpea (Pandey *et al.,* 1991). It is reported that the loss due to pod damage alone goes 42 to 80 per cent (Halder and Srinivasan, 2011). *M.vitrata* larvae feed on flowers, buds and pods by webbing them. This typical feeding protects the larvae from natural enemies and other adverse factors, including insecticides. Moths prefer to oviposit at the flower bud stage. Third to fifth instar larvae are capable of boring into the pods and occasionally into peduncle and stems (Vijayasree, 2013). However, widespread and long-term use of single insecticides resulted in insecticide resistance and biomagnification of insecticides and forcing the farmers to use higher dose and more application frequency by the way chemical; cost labour cost will be increased. Pesticide mixtures may enhance the suppression of arthropod pest population due to either synergistic interaction or potentiation between or among pesticides that are mixed together. It has been proposed that pesticide mixtures may delay the onset of resistance developing in arthropod pest populations (Skylakakis, 1981; Mani, 1985; Mallet, 1989). Mixtures of insecticides provide technical advantages for controlling pests in a broad range of settings, typically by increasing the level of target pest control and/or broadening the range of pests controlled (IRAC, 2018). Recent reports revealed that the pest has developed resistance to the conventional insecticides which are repetitively using from long times. Moreover, no studies have been carried out in Kerala on the efficacy of insecticide mixtures against pests of cowpea.

Materials and Methods

The following insecticide mixtures will be tested for their efficacy against pod borers *M.vitrata* and the insecticides will be applied at 5-10 % infestation level.

Design : RBD

Replications : 3

Treatments : 9

Insecticide mixtures (Ready-mix formulations) were used in the study along with two standard checks *viz.*, chlorantraniliprole, thiamethoxam and one treatment as manual hand mixing of chlorantraniliprole and thiamethoxam (1:1) @ 0.3 mL L^{-1}.

Fifteen plants were selected randomly and number of larvae present in flowers of each plant were counted after 1,3,5,7,10 and 15 days after spraying.

Statistical analysis

The data collected were subjected to analysis of variance (ANOVA) after applying appropriate transformations.

Results and Discussion

Larval population

The lowest number of larvae was found in plants treated with hand mixed product of chlorantraniliprole 18.5 % SC + thiamethoxam 25 % WG (1:1) @ 0.3 mL L^{-1} (1.00) after first day of spraying and it was significantly different from other treatments. Larval population was found in plants treated with chlorantraniliprole 8.8 % + thiamethoxam 17.5 % SC @ 0.3 mL L^{-1}, lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC @ 0.5 mL L^{-1}, chlorantraniliprole18.5 % SC @ 0.3 mL L^{-1} were 2.00 each. Higher population of larvae was recorded in thiamethoxam 12.6 % + lambda cyhalothrin 9.5 % ZC @ 0.3 mL L^{-1} (3.67), thiamethoxam 25 % WG @ 0.3 mL L^{-1} (3.67) followed by flubendiamide19.92 % + thiacloprid 19.92 % SC @ 0.5 mL L^{-1} (3.33) and they were significantly different as compared to control (5.67).

Infestation was reduced after three days of treatment and lower number of larvae was observed in lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC @ 0.5 mL L^{-1} (0.33) and it was statistically on par with plants treated with hand mixed product of chlorantraniliprole 18.5 % SC + thiamethoxam 25 % WG @ (1:1) (0.67), chlorantraniliprole18.5 % SC @ 0.3 mL L^{-1} (1.00), chlorantraniliprole 8.8 % + thiamethoxam 17.5 % SC @ 0.3 mL L^{-1} (1.00). Similarly, number of larvae found in thiamethoxam 25 % WG @ 0.3 mL L^{-1}, thiamethoxam 12.6 % + lambda cyhalothrin 9.5 % ZC @ 0.3 mL L^{-1}, beta cyfluthrin 8.49 %+ imidacloprid 19.81 % SC @ 0.4 mL L^{-1} were 2.67, 2.67, 2.00 respectively and they were significantly different when compared to untreated control (6.33).

After five days of spraying no larvae was found in chlorantraniliprole 8.8 % + thiamethoxam 17.5 % SC @ 0.3 mL L^{-1}, lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC @ 0.5 mL L^{-1} followed by flubendiamide19.92 % +thiacloprid 19.92 % SC @ 0.5 mL L^{-1} (0.67), chlorantraniliprole18.5 % SC @ 0.3 mL L^{-1} (0.67), hand mixed product of chlorantraniliprole 18.5 % SC + thiamethoxam 25 % WG @ (1:1) (1.33). While, the treatment thiamethoxam 25 % WG @ 0.3 mL L^{-1} shown a population of 3.33 and it was statistically on par with thiamethoxam 12.6 % + lambda cyhalothrin 9.5 % ZC @ 0.3 mL L^{-1} (2.67) followed by beta cyfluthrin 8.49 % + imidacloprid 19.81 % SC @ 0.4 mL L-1 (2.00).

No larva was recorded from plants treated with lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC @ 0.5 mL L^{-1} (0.00) treated plot after seven days of spraying and it was significantly different from the other treatments. The treatment hand mixed product of chlorantraniliprole 18.5 % SC + thiamethoxam 25 % WG (1:1) recorded a population of 1.00 and it was on par with chlorantraniliprole18.5 % SC @ 0.3 mL L^{-1} (1.33), chlorantraniliprole 8.8 % + thiamethoxam 17.5 % SC @ 0.3 mL L^{-1} (1.33), beta cyfluthrin 8.49 % + imidacloprid 19.81 % SC @ 0.4 mL L^{-1} (1.33), flubendiamide19.92 % + thiacloprid 19.92 % SC @ 0.5 mL L^{-1} (1.67). Whereas, number of larvae in thiamethoxam 25 % WG @ 0.3 mL L^{-1} and thiamethoxam 12.6 % + lambda cyhalothrin 9.5 % ZC @ 0.3 mL L^{-1} recorded 3.67, 2.00 respectively and they were significantly different when compared with untreated control (6.33).

After ten days of spraying lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC @ 0.5 mL L^{-1} showed no population of *M.vitrata* and it was on par with beta cyfluthrin 8.49 % + imidacloprid19.81 % SC @ 0.4 mL L^{-1} (0.67) which was on par with thiamethoxam 12.6 % + lambda cyhalothrin 9.5 % ZC @ 0.3 mL L^{-1} (1.00). The plants treated withchlorantraniliprole 8.8 % + thiamethoxam 17.5 % SC @ 0.3 mL L^{-1} 0.3 mL L^{-1}, hand mixed product of chlorantraniliprole 18.5 % SC +thiamethoxam 25 % WG @ (1:1) showed 1.67 larvae and they were on par with flubendiamide19.92 % + thiacloprid 19.92% SC @ 0.5 mL L^{-1} (2.00), chlorantraniliprole18.5 % SC @ 0.3 mL L^{-1} (2.00). Thiamethoxam 25 % WG @ 0.3 mL L^{-1} showed 3.67 larvae which is significantly different from all other treatments including with untreated control (6.33).

No larva was observed in lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC @ 0.3 mL L^{-1} after 15 days of spraying and it was significantly different from other treatments. Beta cyfluthrin 8.49 %+ imidacloprid 19.81 % SC @ 0.4 mL L^{-1} showed 1.00 larva and it was on par with treatment hand mixed product of chlorantraniliprole 18.5 % SC +thiamethoxam 25 % WG (1:1) @ 0.3 mL L^{-1} (1.67), thiamethoxam 12.6 % + lambda cyhalothrin 9.5 % ZC @ 0.3 mL L^{-1} (1.33). More or less similar number of larvae were found in thiamethoxam 25 % WG @ 0.3mL L^{-1} (3.67), chlorantraniliprole18.5 %SC @ 0.3 mL L^{-1} (2.67), flubendiamide19.92 %+thiacloprid 19.92 % SC @ 0.5 mL L^{-1} (2.33), chlorantraniliprole 8.8 % +thiamethoxam 17.5 % SC @ 0.3 mL L^{-1} (2.00) and they were statistically on par with each other. The highest population was found in untreated control (6.67) (Table 1 and 2).

Table.1 Insecticide mixtures selected for study

Insecticide mixture	Trade name	Dosage (mL L^{-1})
Chlorantraniliprole 8.8 % + thiamethoxam 17.5 % SC	Voliumflexi	0.30
Lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC	Ampligo	0.50
Thiamethoxam 12.6 % + lambda cyhalothrin 9.5 % ZC	Alika 247	0.30
Beta cyfluthrin 8.49 % + imidacloprid 19.81 % SC	Solomon	0.40
Flubendiamide 19.92 % + thiacloprid 19.92 % SC	Belt expert	0.50
Hand mixing of Chlorantraniliprole 18.5 % SC +thiamethoxam 25 % WG (1:1)	-	0.30
Chlorantraniliprole18.5% SC (check)	Coragen	0.30
Thiamethoxam 25 % WG (check)	Arrow	0.40

Flower damage

Pod damage

Seed damage

Table.2 Population of spotted pod borer, *Maruca vitrata* treated with insecticide mixtures

Insecticide mixtures	Field dose (mL or g L^{-1})	* Number of larvae per plant (DAS)					
		1	**3**	**5**	**7**	**10**	**15**
Chlorantraniliprole 8.8 % + thiamethoxam 17.5 % SC	0.30	2.00 (1.41)	1.00 (1.22)	0 (0.70)	1.33 (1.34)	1.67 (1.46)	2.00 (1.58)
Lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC	0.50	2.00 (1.41)	0.33 (0.87)	0 (0.70)	0 (0.70)	0 (0.70)	0 (0.70)
Thiamethoxam 12.6 % + lambda cyhalothrin 9.5 % ZC	0.30	3.67 (1.91)	2.67 (1.77)	2.67 (1.77)	2.00 (1.55)	1.00 (1.22)	1.33 (1.34)
Beta cyfluthrin 8.49 %+ imidacloprid 19.81 % SC	0.40	2.67 1.62)	2.00 (1.58)	2.00 (1.58)	1.33 (1.34)	0.67 (0.99)	1.00 (1.17)
Flubendiamide19.92% +thiacloprid 19.92 % SC	0.50	3.33 (1.82)	1.33 (1.34)	0.67 (1.05)	1.67 (1.46)	2.00 (1.58)	2.33 (1.67)
Hand mixing of Chlorantraniliprole 18.5 % SC +thiamethoxam 25 % WG (1:1)	0.30	1.00 (1.00)	0.67 (1.05)	1.33 (1.34)	1.00 (1.22)	1.67 (1.46)	1.67 (1.46)
Chlorantraniliprole18.5% SC (check)	0.30	2.00 (1.41)	1.00 (1.17)	0.67 (1.05)	1.33 (1.34)	2.00 (1.57)	2.67 (1.77)
Thiamethoxam 25 % WG (check)	0.40	3.67 (1.91)	2.67 (1.77)	3.33 (1.95)	3.67 (2.03)	3.67 (2.03)	3.67 (2.03)
Control		5.67 (2.37)	6.33 (2.61)	6.67 (2.67)	6.33 (2.60)	6.33 (2.60)	6.67 (2.67)
CD (0.05)		0.221	0.388	0.338	0.323	0.320	0.359

Figures in parentheses are √x+1 transformed values, DAS- Days after spraying, *Mean of fifteen plants

Spotted pod borer infestation in cowpea

By considering results of flower damage, lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC @ 0.5 mL $L^{-1}$is the best effective mixture followed by chlorantraniliprole 8.8 % + thiamethoxam 17.5 % SC @ 0.3 mL L^{-1}.

In 2017, Roy *et al.*, reported similar results in managing pod borer, *M. vitrata* in cowpea by spraying chlorantraniliprole 8.8 % + thiamethoxam 17.5 % SC @ 180 mL ha^{-1}.

However, lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC @ 35 g a.i ha^{-1} was found to be the best in reducing the infestation of borer pests in different crops *viz.*, pigeon pea (Patel and Patel, 2013), soy bean (Birla, 2014), cotton (Bajya *et al.*, 2015), cowpea (Grigolli *et al.*, 2015), brinjal (Sen *et al.*, 2017), pigeon pea (Swami *et al.*, 2017). In Kerala, study conducted by Sreelakshmi *et al.*,2016 revealed that indoxacarb 14.5 %+ acetamiprid 7.7% SC @ 100 g a.i ha^{-1} was found to be effective in managing the resistant population of *M. vitrata* and flubendiamide + buprofezin @ 875 mL ha^{-1} was recorded as best insecticide mixture against borer and sucking pests of rice (Kartikeyan *et al.*, 2012). Several studies has been conducted by using chlorantraniliprole and lambda cyhalothrin as single insecticides against *M. vitrata*. Chlorantraniliprole @ 0.15 mL L^{-1} was found to be superior in reducing larval population of *M. vitrata* in cowpea (Kumar *et al.,* 2014; Yadav and Singh, 2014), redgram (Kumar *et al.,* 2015), pigeon pea (Jakhar *et al.,* 2016). Toxicity of insecticides against pod borers in pigeon pea showed that lambdacyhalothrin 5 EC @ 25 g a.i. ha^{-1} was highly effective in reducing pod borer infestation in pigeon pea (Mohapatra and Srivastava, 2002; Koushik and Pal, 2006; Dhaka *et al.,* 2011; Priyadarshini *et al.,* 2013), Indian bean (Viroja, 2003), green gram (Rani and Eswari, 2008) and in black gram (Sonune *et al.,* 2010).

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How to cite this article:

Banka Kanda Kishore Reddy and Jangam Hampaiah. 2018. Evaluation of Insecticide Mixtures against Larval Population of Spotted Pod Borer, *Maruca vitrata* in Cowpea. *Int.J.Curr.Microbiol.App.Sci.* 7(07): 1820-1826. doi: https://doi.org/10.20546/ijcmas.2018.707.215